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Logic in Early Modern Thought

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Introduction

Logical reflection in early modern philosophy
(EMP) is marked by the instability of the period,
although it is more lasting (the *Port-Royal Logic*
was nevertheless used as a handbook in philoso-
phy courses until the end of the nineteenth cen-
tury). It started in the sixteenth century and ended
in the nineteenth century, a period of 300 years
during which there were deep transformations
in the conceptions of authority and scientific
method. For the history of twentieth-century phi-
losophy, it was the period of "classical logic,"
which lasted from the Renaissance to the linguis-
tic turn conducted by Gottlob Frege. The period

was used to be thought of as centuries of little or
no original contribution to logic, in which con-
ceptions of logic were tainted by rhetoric, episte-
mology and psychologism in the worst sense
(Kneale and Kneale 1962; Michael 1997). From
the last decades of the twentieth century, however,
scholars began to regard this period more accu-
rately with respect to reflection and changes in
logic and semantics. It has recently become a
promising field for historical and conceptual
research; today we can say that the legacy of
early modern logical reformism has a philosoph-
ical, logical, and semantic value in itself.

There are at least three identifiable phases, so
far, in early modern logical reformism. The first
lasts from the middle of the fifteenth to the begin-
ning of the seventeenth century; it is a period of
unprecedented reflection on the nature of logic,
which is the phase of the Renaissance criticism
and regimentation of the Aristotelian-Thomist
apparatus. In the second phase, there are two
strands – that of rationalism, represented by the
Port-Royal Cartesians, Antoine Arnauld and
Pierre Nicole, and that of **empiricism** (Manzo's
entry "▶ Empiricism"), represented by Francis
Bacon, Pierre Gassendi, and John Locke. Each
of those conducted the epistemological turn in
the early modern period in their own way. Then
we may identify the third phase, in which the
relationship with science and language is
established on new bases, with Leibniz's concep-
tion of logic as the most developed expression of
the rationalist strand. In spite of the diversity of

expressions of logical reformism, the path to be presented goes from criticism to the conception of logic as a science of language to a conception of logic as a science of thought (the epistemological turn of empiricists and rationalism) and, finally, to a conception of logic as laws of thought expressible in a language suitable for translation: with Leibniz, logic becomes a logical language of laws of the thought.

Reflection on the Nature of Logic and Critique of Authority: Renaissance Reformism

From the beginning of the sixteenth century to the first half of the seventeenth century, logical reformism could be mostly characterized as a reflection on the nature of logic. It concentrated many expressions of refutation of the medieval scholasticism and also regimented Aristotle's *Topics* and *Rhetoric*. The "topical logic" was used by Renaissance humanists, through criticism of what scholastic tradition consecrated in its use in argumentative disputes (the famous *Quaestio Disputata*) and, also, in negotiations around questions of authorities (ecclesiastical, theological, and political) when some kind of conflict came into play. That is characteristic of dialectical reasoning, in which the syllogism is taken as a discourse (*Topics* 100a25-26) whose nature is not explanatory but of the rhetorical dispute [*in utramque depart dicendo*] aimed at convincing the interlocutor of a thesis that does not need, at first, to be true. The nature of this dialectical and argumentative use is strictly practical and reveals a displacement of the disputed issue to the civil dimension toward the public one (Michael 1997; Wilson 1999).

One of the first representatives of this spectrum of logical reformism is Lorenzo Valla, in his *Dialectiae Disputatione*. Valla's most significant contribution to reformism is the method of textual criticism of classical texts. Inspired by the Latin translations of the Greek classics, by Boethius's *De topicis differentiis*, which follow Cicero's conception of logic as "a system of discourse" (*ratio disserendi*) (Ashworth 2008), Valla applies the

method of textual criticism (Wilson 1999) and uncovers a fraud (the episode of the Donation of Constantine, whose forgery Valla documented in his *De Falso Credita et Ementia Constantini Donatione Declamatio*, in 1439). In doing so, he indicates a path of criticism of authority and ends up bringing the state of the arts to a search for a criterion of the truth. That will be accomplished by Rudolf Agricola. Agricola focused his approach of logic as invention, which becomes the material of what will be judged. So the valid inference begins to depend on a relationship between *inventio* and *dispositio*, in which this latter takes the place of judgment. The elements of inference, however, are purposefully vague constants, to be determined through dispute or by learning rhetoric. In 1479, he published *De Inventione Dialectica*; in it, he introduced the requirement for a veritative criterion (Ashworth 2008).

Petrus Ramus or Pierre de la Ramée, is the most prominent figure of this reformist phase. Ramus rejects the concept of logic as a demonstration and defends logic as an art of speaking well (*ars bene disserendi*), in his work *Dialectique*, from 1555. For Ramus, logic is a practical discipline, in which sorites paradoxes constitute a paradigm in training, without worrying about formal (and ontological) structures. Ramus' reputation, as well as his influence, was immense. The aggressiveness with which he addressed Aristotelian logic also became notorious. On the other hand, he is not recognized as a contributor in any way to logic, and his relevant role, if any, is, rather, as a pedagogical reformer. It is in that condition that the practical and discursive turn of Renaissance logic is understood. At the time of the formation of national states, educational reforms were conflicting with a formally sophisticated logic that had allegedly no practical applicability. Ramus was one of the most famous Huguenot figures murdered on *St. Bartholomew's Night*. It is possible that his murder in these circumstances explains the expansion of the influence of his *Dialecticae* (Kneale and Kneale 1962).

The pedagogical legacy of Ramus may be seen in the work of the Lutheran Philip Melanchthon. The Protestant Reformation introduced new

practical, theological, and philosophical challenges in logical reflection as well. Melanchthon in 1521 wrote *Loci Communes*, and, in his *Opera Omnia*, *Erotemata Dialectices*, he offers a conception of logic as the *ars recte, ordine et precipue docendi*: the art of correct, orderly, and perspicuous teaching. This approach concentrates three separate elements in Renaissance conceptions of logical reformism: logic becomes a discursive art, that is, an argumentative practice, and logic assumes a veritative commitment and is, above all, something that is taught, that is transmitted. This third aspect is what points to the epistemic trait in logical reflection. The truth is not just discourse-dependent of an authority quarrel; it turns to the social demand linked to the birth of national states, in which the transmission and the reflection on the nature of knowledge came into play. Melanchthon exerted great influence on another reformer, the Calvinist theologian Bartholomäus Keckermann. For Keckermann, logic is defined as firstly the *ars dirgens mentem in cognitione rerum*, that is, the art which directs the mind in the cognition of things, and, secondly, the *ars recte de rebus cogitandi*, the art of thinking rightly about things. This second definition suggests the influence Melanchthon exercised over Keckermann and a change in the conception of logic, from a linguistic to an epistemological conception (Michael 1997).

To affirm that logic is a "linguistic" discipline or that it is linked to a language is not to say that there are not, nor can there be, in logic, epistemic requirements. One of the most peculiar reformists that challenge this claim is Jacopo Zabarella, from the Aristotelian School of Padua, a great exponent among those who preserved the root of demonstration of the Aristotelian Organon. He aligns with the Aristotelian method, despite the nuances of his conception of induction, of efficient causality, and of the relationship between logic and science. Among the logicians influenced by him is Johannes Jungius (1587–1657), who studied in Padua and developed a conception of logic as a mental art leading to the discernment of truth from falsity (Mikkeli 1992).

Zabarella's role is doubly important: from the historical point of view, it is possible to identify at the Aristotelian School of Padua the origin and preservation of a classicism which is somewhat a survivor of the rhetorical Renaissance play with little logical relevance. From the conceptual point of view, while insisting that logic would be a theoretical discipline, even if instrumental, Zabarella may be said to have ensured the legacy of the Aristotelian method of demonstration. And he also seems to have inspired Galileo to think about the problems of the method entailed by the difficulty of the "law of regress," as he investigates in the *Tractatio de Demonstratione*, his first work in logic (Mikkeli 1992).

The Epistemological Turn: Early Modern Rationalists and Empiricists

The second phase of early modern logical reformism has two strands of method: rationalism and empiricism. Both criticize the demonstrative root of the Aristotelian Organon. Although traces of the epistemic turn can be found in the throes of the first reformist phase and in the School of Padua, it in fact originates from two events: the impact of Galileo's condemnation on René Descartes' thinking (Friedman, 2008) and the publication of *The New Organon* (1640) by Francis Bacon. Bacon is less of a logical reformist than a philosopher of the New Science. He developed the concept of induction by elimination as the main rule of the experimental method. For both sides, knowledge must precede demonstration; what is at stake in logical reflection is the most suitable method for demonstrating the truth discovered as certainty. Both strands have cultivated similar critical concerns, but the responses offered by each are very different and mark the division of the epistemological turn.

The central figure in the epistemological turn is Descartes, in the wake of the Galilean project. And even though Descartes took the experimental method seriously and should be considered a philosopher of nature and not a logical reformer, his contribution to logical reflection is inseparable from the impact of Galileo's condemnation in 1632. Until then, Descartes was more involved in the "universal mathematization" project

(Friedman 2008; Smith 2010). In 1637, Descartes launched the *Discourse on Method*, which would be the introduction to prudently unpublished texts, and in 1641, the *Metaphysical Meditations*. In these texts, we can verify another path, that of an epistemology characterized by reflection on representations, representations through which two elements are introduced: (1) the response to skepticism with a logical and epistemic subjectivity able to open new ground for the foundation of science and (2) a theory of ideas and judgment reflecting the (still ongoing) change of the ontological landscape. For Descartes, in the *Rules* (AT, X, 405), the prescription of models of syllogistic reasoning for the demonstration of science could serve for the "reason at rest," instead of considering an inference "particularly and attentively." While the first phase of reformism is marked by a certain abandonment of unity in the inferential chain (and the defense of enunciative structures of rhetoric and of commonplaces), this second phase points to a return to units of meaning on a new ground, an epistemic one, for inference. And while Descartes has a form of subjectivity and method anchored in a theory of representation, Bacon opens another way to replace that of Aristotelian syllogism: induction by elimination. The empiricist strand arises from the defense of the replacement of a demonstration model by a projection model, based on the hypothesis resistant to falsification.

The elimination of teleology of the scientific explanatory programs occurs in both strands. Thus, the belief that there would be some "anticipation" in the essence of beings, which will be reflected in the demonstration of science, is abandoned by Bacon, who takes the fact that there is only one description very seriously (as does Galileo), and suggests that also "human knowledge and power are one: for, where the cause is not known, the effect cannot be produced" (New Organon, L, III). The teleological path is replaced by the operation of rule, aimed at commanding nature after having obeyed it (Wilson 1999). The logical thinking linked to Bacon's empiricism is not focused on the organization of ideas but on rules inferred from a projection well-informed and resistant to falsification. The limits of the

projection are the limits of actual knowledge, verified through a procedure of elimination by discovery, not of the true, but of what is false. The method of induction by elimination is not yet, though, a logical method but the search for articulating the appropriate way to deal with science from epistemic and experimental requirements. As Wilson (1999) says: "We are presented with a range of jointly exhaustive and mutually exclusive hypotheses; data are presented which eliminate all but one of the range; it is concluded that the remaining hypothesis is to be affirmed as true. *It is this method that is characteristic of the new science*. (p. 5)." It follows that the premise resistant to verification of the hypotheses of the experiment is true.

In early modern logical reformism, the great representative of empiricism is Pierre Gassendi, who also wrote a logic of ideas, *Institutio Logica* (1658). According to Michael (1997), this manual of Gassendi's logic of ideas greatly influenced the most famous and tenacious manual of modernity logic, which is *Logic, or, The Art of Thinking*, the so-called Port-Royal Logic (Antoine Arnauld & Pierre Nicole, 1683, Translated by Buroker, 1996). Despite the similarity of the presentation of Gassendi's logic to that of Port-Royal, and also the shared criticisms of scholastics, there is little left in common. For Gassendi, before coming into contact with Epicurus' philosophy, logic would be useless. Then (Michael 1997), he reformulates his view toward it: for logic to be anything other than the result of a disputed and unsuccessful argument, it must become useful, and, therefore, it needs to be reformed.

This reform happens through a theory of signs. Gassendi's conception of the sign brings it closer to a logic of the imagination, insofar as the sign originates from sensible experience and constitutes itself as an image of what is hidden in nature or in extra-mental reality. Ideas are signs of two kinds: the empirical ones, originating from the senses whose conceptual nature is "hidden" in nature (e.g., smoke, which is a sign of fire), and the indicative, which depend on the image we form from our senses. These images are the material for the inference; it provides what Gassendi formulates as appropriate anticipation: the

prolepses. Logic is defined as the art of thinking well – *ars bene cogitant*. Thinking well is developing skills: imagine well, present the proposition well, infer well, and order well. The text has four Parts, corresponding to ideas, propositions, reasoning, and method. Each part is focused on training the corresponding skills (representing, judging, demonstrating, and ordering). As Lolordo observes (2005), Gassendi read the *Metaphysical Meditations* as a treatise on logic and opposed Descartes' logical rule: the general rule of truth. According to him, the Cartesian general rule of truth – "everything that I perceive clearly and distinctly is true" – explained in the Third Meditation, lacks criteria, and, therefore, its method as a whole leads to failure. Gassendi remains skeptical about the ability of thought or the purely conceptual way to get to the truth. The empiricist strand commits to epistemic rules linked to the accuracy of knowledge and methods for the new programs of explanation of nature, according to the new science whose ultimate criterion derives from data provided by the senses.

On the other hand, the rationalists focused mainly on judgments. Their paradigmatic logic handbook takes judgment as the mental act which defines logic. It is the Logic of Port-Royal or *Logic, or, The Art of Thinking* (1683), the most celebrated and tenacious logic manual in the history of modern philosophy, which was in the curricula of logic courses until the end of the nineteenth century, when it was buried as the great representative of semantic psychologism.

Logic or the Art of Thinking (The Logic of Port-Royal)

The Abbey of Port-Royal housed, in reformist France, the Jansenists, a Catholic dissent that advocated a return to Augustine. The main link connecting Descartes and the Jansenists is provided by Antoine Arnauld, a central figure in Port-Royal, as well as the influencee of the Augustinian method of ascension, by Descartes, after 1633, when he learned of Galileo's condemnation (Friedman 2008; Hatfield 1997). That was a method of reflection on one's own thoughts and

suspicion of what is accessed by the senses, which recommends that the knowledge of God is achieved through the knowledge of oneself: introspection precedes knowledge of the outside world and to some extent conditions it. The measure of the latter is that of the ground of knowledge reached in the Cartesian response to skepticism, with the cogito argument. The argument "I think, therefore I am" has several expressions and it is not just an argument, but a state of one's own mind's attention, that is, a state of mind (Carriero 2008; Levy 2017). For Descartes and also for the authors of Port-Royal, the *cogito* is a frontier: it is a point of arrival in response to skepticism, and it is a point from which the Meditations of an epistemic subject (a form of subjectivity) will be taken forward. For the Augustinians of Port-Royal, the *cogito* is a theological starting point. In both cases, the privilege of epistemic access to the senses is replaced by the mental activity of a logical subject.

A major representative of the paradigm that became the target of the so-called linguistic turn from the nineteenth to the twentieth century, the Port-Royal Logic would be nothing more than semantic psychologism. It seems irrelevant to note that the project of burying the presence of the logical subject and, more incisively, any epistemic and eventually semantic residue of logic, in its mathematical expression, remains incomplete. In fact, as Hanna notes (1991), "the relative lack of understanding the foundations of the thesis of semantic psychologism (and, consequently both the 'staying power' of the thesis despite repeated criticism, and the disagreement as to the correct antithesis of the thesis) is due ultimately to the failure to identify accurately its *historical origins*." (p. 776). According to this reading, the central problems that occupied the post-Fregean semantics is no more than would of the central problems of the seventeenth- and eighteenth-century epistemology (Hanna 1991; Hacking 1975; Kretzmann 1967). Be that as it may, it is not nearly as easy to establish a fair and enlightened assessment of the nature of logic and judgment when the roots of the actual objects are clarified as part of a real philosophical inquiry,

that is to say, that it deserved a history of investigation into it.

As we will see, the Port-Royal Logic may and should be taken as a real logical handbook, strictly speaking. For Arnauld and Pierre Nicole, authors of the Port-Royal Logic, its form aligns with a voluntarist thinking. The cogito gives itself the objects of thinking: the ideas (*Traité des Vraies et Fausses Idées* – VFI, 2) and their objects are always internal to the representational infrastructure. The reformists' logical texts had the appearance of the medieval logic of terms. In this model, terms are the elements of the utterances in a syllogism (be it a demonstration of science or rhetoric). Terms are categories and propositions that, chained in syllogisms, are at the service of demonstrating the truth or falsehood, the consistency or the inconsistency of reasoning. The logic of terms before Port-Royal and Gassendi does not require any epistemic content. In this way, the demonstration is an instrument (an Organon) to state the validity or consistency of reasoning according to rules that would mirror or translate a stable ontological landscape (Aristotelian-Thomist).

In the new Cartesian landscape, there are two substances, each one with only one attribute: thought is the attribute of the immaterial substance, and extension is that of the material one. A perspective enters the scene in which access and description of the world come to depend on purely rational rules, reducible to adequate representations and judgments of epistemic and logical subjects. The Arnauldian conception of logic, however, responds to the ontological instability engendered by Descartes's (and Galileo's) project, with a subtle strategy. In *Logic, or, The Art of Thinking*, what is at stake is not a metaphysical grounding of physics, but the formation, through education, of logical and moral subjects who should be up to the task of re-founding Christianity, according to the rules of Jansenius and their radical interpretation of the Augustinian doctrines of grace and original sin. They have a global consistency of method, articulating theology, pedagogy, grammar, and logic. The handbook, which has four Parts and had five editions while the authors were alive, has an informative title,

Logic, or, the Art of Thinking. Besides common rules, it contains several new observations appropriate for forming judgment.

The twofold traits in the handbook's title must be taken seriously. To interpret logic as a mental practice the way Port-Royal does is to take it as subsidiary to the Augustinian *cogito* and to the Cartesian theory of representation. In Discourse II, with which they opened the second edition in 1664, the authors responded to the criticisms of the first edition, with a statement about what they considered as logic – "the purpose of logic is to give us rules for all actions of the mind, and for simple ideas as well as for judgments and inferences" – and then they complement: "there is practically no other word which covers all these different acts. Certainly, 'thinking' includes all of them" (LAP, Trad. Buroker, p. 15). Logic, therefore, establishes rules for mental actions, because ideas, for Jansenists, are perceptual mental actions (VFI, 4). Logic, for Arnauld and Nicole, "is the art of conducting reason well, as much to instruct ourselves about them as to instruct others" (p. 23). While it perceives, the mind represents (VFI, 27); the very act of perceiving is, by itself, an idea, from the idea and the idea. Ideas are always mental operations which may be representational or not (AT, VII, 37). When, however, the idea represents, one should expect to have an intentional counterpart of the idea, that is, its object. Then, we may say that the representational structure is twofold: on the one hand, the idea is a modification of thought (it is a mental act that takes the form of a mode of thought) and, on the other hand, it is an object of perception (it is a thought modified by another thought). For Arnauld and in Port-Royal Logic, this counterpart is never extramental, so the object is always an object **of** and **is** in the same representative idea (Nadler 1998).

The "I think" has two kinds of ideas: simple and complex ones (which are a composition of at least two ideas, as in "Alexander is Philip's son" and "Alexander is Philip's son and is a conqueror"; simply "Alexander" would then be just a simple idea). We could take these ideas according to their objects: things, mode or manner of a thing, and modified thing, that is to say, ideas,

attributes, and adjectives (or attributes of attributes). The attributive structure of the handbook is apparently traditional, of the "S is A" type. As the epistemic domain is always virtually present, however, this structure may sound a bit deceptive, for one of the landmarks of this reformist project is the contempt for language. Many of the criticisms of its psychologism and vagueness are due to the neglect of this *parti pris* running through the text. Contempt for language is consistent with the Augustinian doctrine of original sin, which informs the semantics and the relationship between ideas and terms, terms and propositions, and propositions and judgment and between the procedures of restriction (Buroker 1996; Pariente 1985), of the handbook.

In this doctrine, the Fall led to the discovery of the embodied desiring condition, which entails opacity among minds that were hitherto transparent to each other. So, the use of words and language stems from a sinful and, therefore, less reliable condition. In Port-Royal, this is a theory about the relationship between thought and language, about the etiology and "posology" of language. Therein lies the foundation of the priority of thinking over the use of words and also of the idea over the linguistic expressions. This is the explanation for the fact that, despite being a logic of terms, the Jansenist handbook may be taken as a logic of ideas, in the first place. That is because in it, terms need not correspond to ideas in a one-to-one relationship. In a proper sense, neither terms nor judgments are ideas, and this is not clear to an external reader, because authors often seem to treat terms as ideas and vice versa (after all, they do not care very much about the expressions used). Thus, when the authors say, in the complement of the title "containing, besides common rules, several new observations appropriate for forming judgment," they are explaining the hybrid structure that makes this text so peculiar: there is an appearance of logic of terms; there is the presentation of Aristotle's categories and also of the five universals, the Third Part, which is the largest one of the manual, is dedicated to the syllogism; however, mentioning and using these expressions is equivalent to using a dead horse carcass to hide or warm up. Semantics, applied by

a logical and epistemic subjectivity, is parasitic on the conception of the art of thinking, which means inference by reflection.

These elements explicit the constituents of the handbook. The order of presentation of what will be within sheltered the logical terms (subject and attribute) is as follows: ideas are the minimum epistemic units (which is not the same as the unit of meaning) (First Part, 1), ideas have intra-mental objects, and it is in this condition that they have any logical relevance, that is, in their plasticity: ideas are things, manners of things, and modified things (First Part, 2). Aristotle's ten categories are mentioned to "show" their irrelevance, the way they are a "pure carcass" (First Part, 3). Ideas have a formal sign nature (First Part, 4): ideas are ways of thinking about something. From the duplicity of ideas rises the possibility of considering them in their compositionality or simplicity when introducing two modes of thought: abstraction and specification (First Part, 5).

Abstraction allows for generalization. Examples of abstraction: the "I" comprises the "I think"; the equilateral triangle comprises the triangle. But both the "I" and the "triangle" are "less determined" and, therefore, can represent more individuals. Now, simple ideas represent just one thing, an individual, whereas general or common ideas represent more than one individual. The complexity of the representational infrastructure will be instantiated in ordinary language, in which thought is "marked" through the names of individuals. We identify general ideas and simple ideas by the markings in the language, or by the "nomination" of the individual or the individuals represented. Thus, Socrates, Rome, and Bucephalus are names of individuals, whereas Man, City, and Horse are common names which can represent several individuals. Common names can be ambiguous, and for this reason, the authors require attention to the introduction of a semantically oriented look at the two modes of using common names.

The first use is univocal: it should be considered that common ideas are univocally used when referring to one thing. For example: "horse," "city," "man" may be taken as common names with univocal use. Then, the common name

"horse" refers to **the idea** of horses in general or **to the idea of** individual horses (that is, independently of its nomination); or "city" refers to the idea of city, in only one sense that is applied to an idea of a city as such. The use is univocal because the names referred to individuals or to classes of individuals as if it were one and only kind of thing, namely, the idea falling under this common name, with one single possible meaning. The second use is equivocal: it involves different uses of the same word the sense of which is a pragmatically fixed meaning, in a context of speakers. That is to say: the second use is plunged within the natural language. The latter opens a space to understand, in the treatment of singular terms, how it is possible to grasp the boundary of logical space in the representational domain. The use of equivocal expressions expounds, then, the logical space, if we orient ourselves through a semantic rule: the Port-Royal Law, which will be explored below. Due to the possible gap between the form of representation and the object represented means that some regulation of restriction is needed (First Part, 6).

Each idea has at least one comprehension and may also have an extension. The comprehension of an idea is made up of attributes without which it is not thinkable. The extension of an idea is that to which the comprehension of that idea applies, be it an individual or groups. Through the semantic distinction between comprehension and extension of the idea, we may grasp its implications. The extension denotes the individual or individuals to which the comprehension of the idea applies to. The extension requires rules to restrict the idea. The extension of an idea can be restricted when a determination is added to a general idea, for example, when the idea of a triangle is added to that of a right triangle. One may also restrict an idea by adding a quantifier such as "some" to the comprehension of the general idea. Thus, when thinking about a triangle, we say "some" triangle. This type of determination or restriction is called an "indistinct" and "indeterminate" restriction (First Part, 6).

Here is the Port-Royal Law: the greater the comprehension, the smaller the extent of an idea is. And the lower the comprehension, the greater the extent of a general idea is. This can be translated as follows: the fewer attributes an idea has, to more individuals may its objective reality (i.e., its comprehension) be applied to. The more abstract and general it is, the less particular it is. This is not trivial, however, because (1) the individuals to which general or common ideas apply are not pre-determined in any extra-representational reality and (2) comprehension is neither an essence of a substance nor an element external to thought, but an idea of an idea: it is, therefore, a strictly semantic disposition. For example, the idea of a square circle has no comprehension (it fails to have any possible meaning) and, therefore, cannot have any extension, first of all, because without comprehension there can be no extension.

The reverse does not happen, though: ideas can be comprehended without any extension: I can think of a table with a turtle shell and call it "turtable." I can have an idea of a table and an idea of a turtle shell; then, I may very well compose both of these ideas: a table whose top is a turtle shell. However, as far as I can tell, there is no extension of this idea. The "turtable" (say, the name of that combination) is an idea, bearer of a comprehension, without any extension whatsoever. The intelligibility of the handbook is guided by its method requirements. It also recommends taking language as somewhat a bitter medicine. The use of language to mark epistemic thoughts and content obeys, in some cases, a sort of peace agreement. Thus, the intertwined relationship between logic and grammar governs propositions, judgments, and predicates, eventually with the structure of past propositions being used as actual terms, as merely complex ideas housed by some term function (First Part, 8 and Second Part, from 4–14).

For example:

1. The turtable is used in an official ceremony
   S (= The turtable) is A (= used in an official ceremony)

We may see two complex ideas there (mere composition of two simple ideas) side by side:

(a) A turtable is a complex idea and, at the same time, is a simple term: the subject of proposition (1).

(b) It is an attribute which may be taken as a complex idea, that is to say, the combination of two ideas: the idea of official and the idea of ceremony. Together, these ideas may seem to be just a term, but within it there is an already made judgment, due to the propositional content of the attribute. There is an official ceremony, accordingly, because the judgment "the ceremony is official" is implicit in an attribute in which it plays the role of a logical term, sheltering a complex idea.

If we analyze the turtable following the rules expressed in Chap. 5 of the Second Part, we are compelled to consider its logical nature and constituents as expressing a judgment. This would go like *the table is made of a turtle shell as its cover.* When enunciated in (1), however, the copula does not behave as such, for it is implicit; that is to say, complex ideas with propositional content can play different logical roles as terms (that is not to say that judgments may be subjects and attributes but that in each term-S and in each term-A there could be *n* ideas and, so, *n* ideas with propositional, therefore judicative contents). Thus, the former judgment reveals itself as a simple term, a subject, in an actual proposition, as part of a judgment in the condition of a complex idea sheltered by a logical term. The proposition (1) may also be analyzed grammatically:

2. The turtable, that is, a turtle shell table, is used in a ceremony, which is official

Complex ideas with propositional content can play the role of incidental propositions, like the one inserted by the relative pronouns ("that" and "which") included above. Given the possible gap between ideas and terms, an S-term can harbor an *n* number of ideas, and the same occurs in the attribute function. That dynamic of incidental propositions makes the distribution of the truth values problematic and seems to weaken the classic structure of the proposition (Buroker 1997), due to the possibility of repeated recursion

(Buroker 1996) in the handbook. But that seems to be somewhat treatable, should the methodological requirements be taken seriously.

A proposition is the union or separation of at least two ideas (Second Part, 3), and, they say next, this operation is also called judgment. Then, they clarify: it is not enough to conceive the two ideas or two terms, because *it is necessary that the spirit connects or separates them.* This connection or separation is made by the "I think," and so the boundary between propositional space and assertoric stroke can govern incident and principal propositions. That is how it can be "enough that there is an express or virtual judgment or statement" (Second Part, 7) to decide whether or when incidental propositional components distribute their true value to a total judgment or not.

The comprehension of the subject includes the comprehension of the predicate, and the extension of the predicate is the quantified part of the proposition (Buroker 1997). When it is said, then, that if S is P, that carries an elementary identity between subject and attribute; according to Port-Royal, it would have in fact this: all a is b which is a, or, still, all a is (some) b. Quantifiers are syncategorematic expressions in Port-Royal. The idea of an attribute then is not taken according to its extension, unless its extension is greater than that of the attribute (as in the case of "they are animals," in the proposition "all men are animals" since the extension "animals" is greater than that of men so that the reason "all men are animals" should be taken as "all men are (some) animals"). That kind of implicit quantification reinforces the strength of the method in the manual and nuances the "classic logical" character of the handbook. There is no identity between subject and predicate, but an asymmetric relationship between components of judgment. This asymmetry makes their theory of copula another curious example of its hybrid character, regarding the conditions for a "peace agreement" between the domains of thought and language, in the most famous seventeenth-century logical text.

Leibniz's Conception of Logic: The Development of the Rationalist Path

As occurs with Leibniz's metaphysics, the Leibnizian conception of logic can only be understood in a satisfactory and comprehensive way if we take into account that it consists, to a certain extent, in a reaction to the concept of logic expressed or tacitly accepted by modern philosophers as Francis Bacon, René Descartes, and Antoine Arnauld. Leibniz disagrees, first of all, with the strongly negative evaluation of Aristotelian-scholastic logic which is based on its alleged sterility and uselessness with regard both to setting up first truths that could serve as foundational bases of the sciences and to making discoveries that contribute to an effective expansion of the field of knowledge. He also does not understand it as a mere instrument that provides us with only valid rules of inference, although, of course, it also fulfills this function. Secondly, Leibniz deeply disagrees with an epistemic understanding of logic, which can be found, in an exemplary way, in *Logic, or, The Art of Thinking*. In this book Arnauld and Nicole present what they call a new logic, which contains investigations on the rules of good thinking through an investigation on the operations of the spirit. The main goal of these investigations is making it possible to avoid the mistakes that we make day after day and that keep us from discovering the truth. Therefore, the Port-Royalian logic is structured around the four mental operations attributed to understanding, namely, conceiving, judging, reasoning, and ordering, unveiling the rules of thought specific to each of these operations. It is because of an assumed anteriority and independence of thought in relation to language that Port-Royalian logic takes the operations of thought as the object of study of logic.

It is true that, in several of his texts (GP VII, 82–85; and 514–527), throughout his life, Leibniz also characterizes logic as being an art of thinking – *l'art de bien penser*, *ars cogitandi*, *Denkkunst*, *Vernunftkunst* (L, 463; GP VII, 516) – but it is important to emphasize that this art does not involve, in Leibniz, a description or an investigation neither on mental entities located in the spirit nor on mental operations executed by it. Rather, it deals with the settlement or discovery of the rules for the formation of symbols and with the execution of operations that enable us to deduce certain propositions from others. For Leibniz, it is not possible to think without using signs of some kind (L., p. 183), in such a way that these formation rules for concepts, judgments, and reasoning must be understood as referring to operations on signs. So thinking consists in calculating, being nothing more than a manipulation of signs according to certain rules. In this way, the development of an art of thinking is, in Leibniz, inevitably linked to the establishment of a general doctrine of signs, that is, of a semiotics, and a doctrine that institutes laws that determine these operations.

This characterization of logic as an art of thinking coexists, in Leibniz's texts, with the statement that logic consists in a science, more specifically, in a general science (*scientia generalis*). The relationship between these two conceptions – *ars cogitandi* and *scientia generalis* – does not correspond either to a temporal evolution in Leibnizian thinking about logic, given that both conceptions are equally present in texts after the 1680s, or to a possible equivocality in the use of the term "logic" by Leibniz, which would indicate that he would use this term to designate things that would not have any kind of internal link between them. Rather, they are, in our view, two somewhat complementary perspectives on what logic is. From a methodological or instrumental perspective, logic presents itself as the simple art of thinking, containing, on the one hand, the rules to be followed for a correct deduction – *ars judicandi* – and, on the other hand, those that should allow discoveries, *ars invenienda*. From a doctrinal point of view, however, it appears as an area of knowledge in its own sense, that is, not only as a set of rules to be adopted for knowing correctly but as a subject matter to be known itself. The scope of that which logic deals with is as wide as possible, leading Leibniz, in some texts, to identify it, ultimately, with metaphysics.

Leibniz's admiration for Aristotle as a logician stems not only from the recognition of the value of the results he reached but mainly from the fact

that, for him, Aristotle was the first to think of non-mathematical objects in a completely formal way, which enabled him to construct demonstrations out of mathematics (C, 177). In a letter to Gabriel Wagner, in 1696, Leibniz states that "it is certainly no small matter that Aristotle reduced these forms to unerring laws, having been the first to actually write mathematically outside of mathematics" (l, 465). What belongs to logic is, therefore, for Leibniz, the formulation of proofs and demonstrations that work by virtue of their form, and not because of their matter or the content of propositions. Leibniz considers Aristotelian syllogistics as the first achievement in this area, but "it is simply unnecessary for all forms of proof to be labeled *omnis*, *atque*, and *ergo*. Into all infallible sciences that are exactly demonstrated, higher logical forms are incorporated, some of which come from Aristotle, some of which must find their source elsewhere" (L, 465). Thus, the Aristotelian-Thomistic syllogistics, far from encompassing the totality of logic, consists, for Leibniz, of a calculation that involves certain logical forms, but not all possible forms.

One of the main goals pursued by Leibniz in the course of his work is precisely a critical investigation of the principles and laws on which logical calculations are based. It makes possible, on the one hand, to give strict reasons for the existing symbolic calculations and, on the other hand, to formulate new calculations involving the discovery and development of other logical forms. Thus, it is a project to expand traditional logic by developing more general and broader calculations. In his strictly logical texts, written mostly between 1679 and 1690, Leibniz pursued two different but connected goals: (a) to substantiate the syllogistics, establishing basic laws from which the syllogisms derive, and (b) to develop different calculations with the final purpose of formulating a universal calculation, which would then provide the formal framework for the most diverse arguments. Among these calculations, we can identify (a) a calculus of concepts, developed within *General Inquiry about the Analysis of Concepts and Truths* (P, 47–87), from 1686; (b) the development

of a quantifiable system which, besides quantifying concepts, introduces a quantification of individuals, also in *General Inquiry*; and (c) the calculation known as "plus-minus-calculus," introduced in the text *A Not Inelegant Specimen of Abstract Proof* (P, 122–130), which consists in a calculation that mainly involves addition and subtraction operations, which are abstractly understood. A notable exhibition and reconstruction of these calculations can be found in Wolfgang Lenzen's masterful works (Lenzen 1990, 2004a, b).

This leads Leibniz to consider logic as being a s*cientia generalis* (C, 556), understanding under that term a science that contains the principles of all other sciences as well as the method for using these principles, which would enable the discovery and establishment of truths in all areas (A, VI, 4–32). For this project to be implemented, this *scientia generalis* must be linked, on the one side, to a *characteristica universalis*, that is, to a universal doctrine of signs, whose task is to build a formal language that expresses the conceptual relations established by *scientia generalis*. This *characteristica* must have basic terms that correspond to the basic elements that make up our thinking, thus forming both a kind of alphabet of thoughts and a syntax related to its connection laws. On the other side, it must also be linked to an *encyclopaedia*, whose materials or contents will be systematically linked to one other, constituting a demonstrative encyclopedia.

The universal nature of *scientia generalis* inevitably takes it closer to metaphysics, leading Leibniz, at times, to even identify one with each other (see, e.g., the letter from November 1678, to Countess Elizabeth: *car j'ay reconnu que la Metaphysique n'est gueres differente de la vraye Logique, c'est à dire de l'art d'inventer en general*: A, II, 1, 662–663). The point is that Leibniz also understands *scientia generalis* as a science of what is thought as such (*Scientia Generalis nihil aliud est quam Scientia de Cogitabili in universum quatenus tale est*; A, VI, 4, 527), that is, of what can be conceived without contradiction. As, for Leibniz, being is everything that can be thought of in a logically consistent way, so a science of what is thinkable coincides

with the science of beings or things in general. In that way, logic, as a *scientia generalis*, ends up corresponding to metaphysics, understood as a formal and general ontology.

Abbreviations

(A) – Leibniz, G.W. (1923 ff) Sämtliche Schriften und Briefe, Reihe I–VIII. Akademie Berlin, Darmstadt.

(C) – Leibniz, G. W. (1988) Opuscules et fragments inédits, edited by Louis Couturat. Olms Verlag, Hildesheim.

(GM) – Leibniz, G.W. (1971) Mathematische Schriften, hrsg. von Gerhard, C.I., 7 vols. Olms Verlag, Hildesheim.

(GP) – Leibniz, G.W.: Die Philosophischen Schriften, hrsg. von Gerhard, C.I, 7 vols. Hildesheim: Olms, 1960–61.

(L) – Leibniz, G.W. (1989) Philosophical Papers and Letters. Kluwer, Dordrecht/ Boston/London.

(P) – Leibniz, G.W. (1966) Logical Papers, ed. by Parkinson, G.H.R. Clarendon Press, Oxford.

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